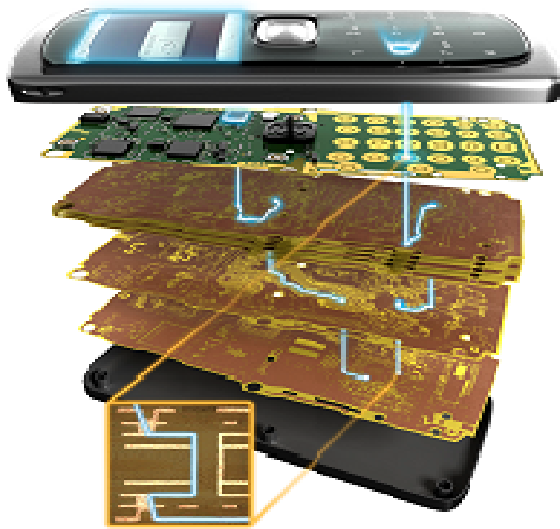


## Run Like An Egyptian

You may remember the song 'Walk Like An Egyptian' but how to run like Egyptian? It took decades to build a pyramid on the Nile. It was an enormous effort which consumed a mountain of stone and thousands of workers. How, though, to make a pyramid in 7 days with 100 people? Finnish printed circuit board producer Aspocomp Oulu enjoys a challenge.

Modern printed circuit board (PCB) for mobile phones resembles a pyramid in several ways. It has multiple layers and 'stones' placed one on top of the other. The foundation has to be built very precisely, otherwise the 'top' of the pyramid will fall. A PCB is also full of connection tunnels for electrical signals to pass through. On the other hand, there are some slight differences. A pyramid weighs about 5 million tons and is a very stationary entity. A typical mobile phone PCB, however, weighs only about 10g approximately and has been designed for a mobile device.

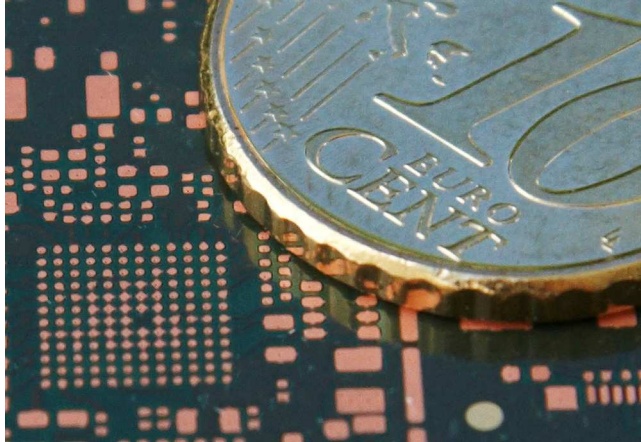
As an example of how to make modern pyramid, we will look now at a printed circuit board (PCB) that provides connections to 0.4mm component with 200–300 pins.



Pic 1. A modern pyramid inside a mobile phone

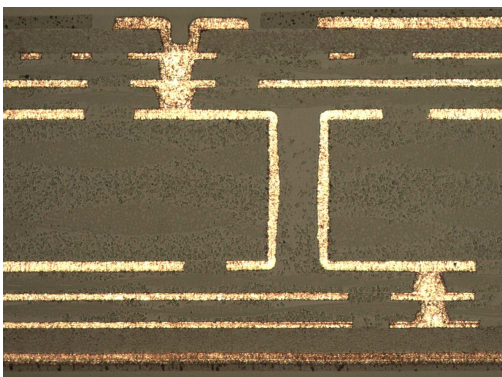
This type of PCB has to be built from the center outwards. Firstly, the PCB manufacturer makes the double layer PCB in the middle, having mechanically-drilled buried holes. The manufacturing of this layer consists of drilling, copper plating, pattern imaging, etching and automatic optical inspection. To make the first microvia layers on the top of a double-sided PCB, the manufacturer needs to use pressing, laser drilling, copper plating, imaging, etching and automatic optical inspection. This sequence will repeat 2 more times to make a complete PCB. In total the PCB needs to make no less than 4 rounds of the main PCB processes.

In its entirety the processing consist of 84 main steps in process flow, each having several sub-steps. Each step has its own high precision machinery with obligatory setup time for each machine. All this needs to be completed in 7 days, effectively making the people at our Oulu plant to do systematic, 4-lap run around the factory. In a sense, you might say that they 'Run Like An Egyptian'.



Pic 2. 0.4mm pitch component footprint on PCB.

" When we started with multiple microvia layers, this was difficult to do", explained Jari Isoaho, CEO of Aspocomp Oulu. "But now we have quite effective production control systems, good selection of laminate materials, capable machinery in good shape and, above all, professional and experienced staff." Jari Isoaho goes on to say that it is important that the PCB company, making a quick turn around, is in good economic shape. These kinds of deliveries require production in 3 shifts, usually also at weekends and involve quite a lot idle time in the process lines. Aspocomp Oulu often needs to keep machines in standby mode in order to get incoming express order up and running right away. This means that the factory cannot be fully loaded if it is in the quick turn around business.



Pic 3. Cross section of a 'pyramid'. This PCB has 8 connection layers and 3 buildup layers on each side. It passes through the PCB process 4 times, layer by layer before it is finally complete.

One technical challenge comes from the fact that very complex electronic functions have to be packed into an available space that is very small . The processors and other components are, therefore, very dense, down to 0.4mm pitch. Pitch is the distance between individual connection

pins in the component. Most critical issues in manufacturing process are layer to layer alignment and capability to do very narrow copper conductors, down to 50 $\mu$  (0.050mm). Laser direct imaging and high precision x-ray alignment systems provide the key to unlock this capability.



Pic 4. A large machine to make small PCBs. Copper plating line in Oulu.

Since 2000 most European PCB manufacturing has been moved to Asian countries, mainly China. This applies especially to volume manufacturing. Now European manufacturers need to concentrate on high technology and flexible services for local customers. Aspocomp Oulu has been able to develop capability to make complex PCBs within a very short delivery time. This is a good 'window' in which to compete with Asian PCB manufacturers, being the 'last man standing' for high technology PCBs in Nordic Countries.

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